**Figure 1** Plastic bottles and other plastic debris litter coastlines around the world. Often used only once before being discarded, a plastic bottle can take up to 450 years to biodegrade. (Creative Commons – https://pxhere.com/en/photo/758917)

# Plastics in our oceans: learning and acting

## Marine biologist **Russell Arnott** discusses the environmental and health issues around ocean plastics and what we can do

The chances are, if you can name it, it can be made from plastic. Plastic is an amazing substance; it is durable and cheap to produce and yet it is these properties that also make it problematic. Unless you have been hiding under a single-use plastic bottle, you will be aware of at least some of the issues around plastic, or rather our use of plastic.

### What's the issue with plastic?

We have clearly done something positive when we place that plastic bottle in the recycling bin, right? Alas, studies show that only 4% of the plastic that we send for recycling actually gets recycled. Often our plastic is shipped overseas under the illusion that it will be recycled. With limited waste disposal infrastructure and legislation, this plastic arrives in a new country and is simply dumped somewhere; out of sight, out of mind.

I try to avoid quoting big numbers because our brains just register it as 'big', but here goes. If I told you 12,000 tons of plastic were added to our ocean every year, you would be shocked. If I told you the actual number is *12 million tons every year*, you would be rightly horrified.

The durability and variety of plastics mean that they can take an age to break down (or biodegrade) in the environment. Plastic carrier bags will be around for 50 to 100 years, plastic bottles for 600 years, and Styrofoam/polystyrene containers for a whopping 5000 years. As more of these plastic items are added to our ocean, they just build up and up. Waves and sunlight break large pieces down into smaller and smaller fragments, which enter the food chain and then concentrate in living organisms in a process called bioaccumulation.

The plastic that is recycled is usually shredded into fibres and turned into linings, carpets and fleeces. This sounds great but, when washed, these can shed hundreds of plastic microfibres, which then enter our waterways. Just by innocently washing clothes, a city can contribute the equivalent of 5000 plastic bags to our ocean *every day*.

As more of our food and drink is packaged in plastic, we are consuming microplastics, eating around the equivalent of one credit card each week. These plastic particles bestow upon us an array of chemicals and toxins, causing various health issues that we are only just starting to study.

**Figure 2** A Laysan albatross chick found dead on Midway Island in the North Pacific Ocean. Easily mistaken for food, brightly coloured pieces of plastic are inadvertently collected by the parents and then fed to offspring. The plastic fills the chicks' stomachs, malnourishing them and later preventing them taking flight. Once the chick dies and decays, the plastic fragments remain in the environment continuing to harm wildlife. (Photograph by Chris Jordan from his film *Albatross*, available at: www.albatrossthefilm.com. FlickrCommons, CC BY 2.0)

### What can we do about it?

As consumers, we should try to avoid single-use, disposable anything; even

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'biodegradable' plastics use up Earth's resources, take years to break down and come with their own carbon footprint, often greater than that of plastics. Getting your own reusable water bottles, coffee cups and canvas tote bags is a good first step. Buying locally and seasonally not only cuts down your carbon footprint but also the need for plastic-wrapped produce.

It is important not to become despondent: we can all play a part in reducing our plastic footprint, but ocean plastic is a multi-faceted issue that is going to require serious governmental intervention to get companies to take responsibility for the plastic they produce.

Here at Incredible Oceans, we have been collaborating with Fuse School to make a series of ocean-themed videos linked to the National Curriculum in England; check out our Ocean Plastic video (see *Weblinks*).

## Activities for schools

Below are suggestions for a number of activities that you can do at school to help reduce and reuse plastics, while engaging learners in the reasons why it is important to address the plastics issue.

### Carry out a litter pick

Many schools have their own litter-picking kits but councils have kits to borrow. The Marine Conservation Society run a number of national beach cleans every year; for schools close to the coast, this is a good way to engage children with the issue of ocean plastic, while empowering them to make a real difference. For inland schools, it is important for the children to understand that all rivers flow into the ocean, so it is also possible to do an inland 'beach clean'.

The interesting part comes after the clean-up, when you can analyse and categorise the litter. What type of items did you find? Which companies made the items? This is a great opportunity to include numeracy by graphing the findings, and literacy by writing to the companies responsible and your MP.

### Remoulding polystyrene

You will need polystyrene pieces, a glass bowl, acetone (or acetone-based nail-varnish remover) (please consult CLEAPSS or SSERC for safety advice about how to use and manage this liquid).

Polystyrene/Styrofoam is used in beanbags, fast-food boxes and protective packaging. Not only does it take 5000 years to break down, it is also generally non-recyclable. This simple activity introduces children to ideas of recycling as well as material properties of plastics. Take some pieces of polystyrene and place them in the glass container. Add a small amount of acetone (nail-varnish remover) and the polystyrene should fizz and liquefy before your eyes. The acetone causes the polystyrene to liquefy, removing the air that was injected into it. The liquid polystyrene can now be handled and remoulded into new shapes, eventually solidifying once the acetone evaporates.

A risk assessment and further details for this activity can be found in the RSC 'Disappearing plastics' activity (see *Weblinks*).

### Make your own bioplastic

You will need a pint of cows' milk, a saucepan, stirring spoon, white vinegar, tablespoon and sieve.

This is a great demonstration showcasing how natural substances can exhibit plastic properties. Gently warm approximately 300 ml of cows' milk on a hot plate or in the microwave. Add 2 to 3 tablespoons of white vinegar and gently stir; the milk will start to curdle. Milk is mainly water but also contains a protein called casein; adding vinegar (acetic acid) lowers the pH of the milk, making the casein come out of suspension. Sieve the curdled milk to extract the casein; this can be moulded or rolled flat and cut into shapes as you would pastry. Leave for 24 hours to harden and then paint and decorate.

### Bioaccumulation food chain tag

You will need a pen, 14 small pieces of paper and a space for the children to run around in.

This game is a fun way to illustrate how plastic can build up (bioaccumulate) in big animals. For a class of 30, get 14 small pieces of paper and put an X on the back of seven of them. The paper tokens represent energy from the Sun and the X a piece of plastic. Out in the playground, split the class into groups: plankton (14 pupils), fish (10 pupils), seals (4–5 pupils) and orcas (1–2 pupils). You, the teacher, are the Sun and distribute an energy token to each plankton and get them milling about. Then send in the fish to catch the plankton. When a plankton is caught, they give their energy token to the fish and sit out. With all the plankton out, next send in the seals to catch the fish. Again, the fish relinquish their tokens when caught and sit out. Finally, in come the orcas at the top of the food chain, eating the seals to get all the energy tokens. Gather the class and get the orcas to show the class what they have eaten. Highlight the Xs and explain how animals inadvertently consumed plastic and how it builds up inside animals higher up the food chain.

**Figure 3** A single-use polystyrene cup litters a canal. Used for an average of 12 minutes, this item will exist on Earth for 5000 years, as long as the pyramids have already been here for. We are now finding more sustainable alternatives to this polystyrene but can we come up with a solution for the vast amount we have already produced? (Creative Commons – https://pxhere.com/en/photo/537790)

### Weblinks

Incredible Oceans: **www.incredibleoceans.org**

Fuse School: **www.fuseschool.org**

Ocean Plastic video: **https://tinyurl.com/v5t8khx**

Disappearing plastic (RSC): **https://edu.rsc.org/resources/disappearing-plastic/1721.article**

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